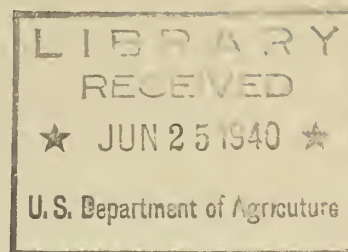


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UNITED STATES DEPARTMENT OF AGRICULTURE
Agricultural Marketing Service



INFORMATION ON HAY QUALITY
FOR
DAIRY HERD IMPROVEMENT ASSOCIATION TESTERS

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Washington, D. C.
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High-quality hay, in liberal quantity, is essential to efficient feeding of dairy cattle. There seems to be no doubt that farmers lose millions of dollars each year because of unfamiliarity with certain important principles which are involved in producing high-grade hay. The opinion seems to be justified that in many areas the value of the hay crop could be increased fully 25 percent without increasing the acreage, by cutting at the proper stage and by adopting better methods of curing, handling, and storage to preserve quality.

If the full capacity of dairy cows for utilizing forage is to be realized, hay should be palatable and nutritious. A ton of high-grade hay supplies considerably more digestible nutrients than a ton of low-grade hay of the same kind.

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Quality Defined

Quality in hay really means feed value. Thus when we measure the different factors of quality we are determining the feed value of the hay. The physical factors of quality that may be readily gaged in a practical way are (1) stage of maturity or ripeness when cut, (2) percentage of leaves, (3) percentage of natural green color, (4) percentage of foreign material, (5) condition as to soundness, and (6) size and pliability of stems.

Generally speaking the above physical factors go along with the chemical composition of the hay. Hay that is of good quality as gaged by its maturity, leafiness, color, and other physical factors will, in most cases, furnish the greatest quantity of nutrients.

Quality in hay from a chemical standpoint refers mainly to its protein, carbohydrates, mineral, and vitamin content and to its digestibility.

The quality or feed value of hay is reflected by the growth, gains in weight, reproductive ability of the animals, and the milk, meat, and other products which result from its use.

Hay Quality Specifications

Good quality - (U. S. No. 1)

Shall be early cut, leafy, natural green, fine stemmed, relatively free from weeds or other foreign material, sound, and sweet.

Medium quality - (U. S. No. 2)

Hay of medium or average quality, includes hay that does not meet the requirements for good hay and is above the requirements for poor hay. It shall be at least moderately leafy, green to greenish brown or yellowish green; it may contain an appreciable quantity of weeds or other foreign material; and it shall not be coarse and woody, overripe, musty, or moldy.

Poor quality - (U. S. No. 3 and Sample grade)

May contain a low percentage of leaves; may be brown or otherwise very low in green color; badly overripe, badly weathered, musty, moldy, coarse, and woody; may contain an excess of weeds or other foreign material, or more than a trace of injurious foreign material such as sand burs (mechanically injurious) or whorled milkweed (poisonous).

Relation of Important Factors of Quality in Hay to Feed Value

The most important visible factors of quality in hay are: (1) stage of maturity when cut, (2) percentage of clinging leaves in the case of legumes, (3) percentage of green color, and (4) soundness.

Minor factors of quality in hay include (1) foreign material such as weeds, rakings, grain stubble, etc., (2) texture and softness of stems, and (3) aroma.

Stage of maturity

The stage at which grass and legumes are cut for hay influences the composition, palatability, digestibility, and length of time required to cure the hay. As the plants approach maturity the percentage of protein and carbohydrates diminishes and the percentage of crude fiber increases. Late cutting not only results in actual loss of nutrients, but the hay becomes less palatable and more difficult to digest. The quality of many excellent crops of hay is virtually sacrificed after the hay is ready for harvest because of late cutting. Even with perfect curing weather it is impossible to produce high-quality hay from late-cut grass and legume crops. Late-cut hay which has lost some of its green color or leaves before cutting cannot lose an additional quantity during the curing process without becoming medium- or low-grade hay. Late-cut hay does have a slight advantage over early-cut hay in the length of time required for curing but in most cases the loss of color and leaves due to maturity more than offsets this advantage.

Proper stage for cutting

The proper stage of maturity at which plants should be cut for hay varies slightly in different sections of the country. Based on research findings and the practical experience of farmers, however, it appears that the different hays should be cut about as follows:

Timothy - from the early to full-bloom stage

Red Clover - when in half to full bloom

Alfalfa - when the plants are about one-tenth to one-fourth in bloom or about the time the first basal shoots appear. In those areas where alfalfa blooms sparingly it should be cut when the foliage shows a yellowish tinge, indicating a slowing up or stopping of growth

Soybeans - when the seeds are one-fourth to one-half developed.

Johnson grass - when the first heads appear from the boot.

Oats and wheat - when the grain is in the milk stage, except that oat hay, which is to be fed to horses, may be cut when the seed is in the dough stage.

Vetch - when the seeds in the pods on the lower half of the plants are one-half developed.

Lespedeza - when in full bloom.

Cowpeas - when the first pods begin to ripen and turn yellow, but before any of the pods are mature enough so that the seeds would be shattered during handling.

Bermuda and miscellaneous grasses - not later than full bloom.

It is true that some of these hays will make more desirable dairy cattle feed if they are cut at an earlier stage of maturity, but from the standpoint of all factors such as yield, effect on stand, etc., the stages of maturity given above have been found to be most satisfactory.

Determining maturity of cured hay

Timothy - The stage of maturity at which timothy was cut for hay can be determined easily by rubbing a few timothy heads in the palm of the hand. If it was cut not later than full bloom, no ripe seeds will be present and parts of the flower can be seen. Occasionally a few small, green, partly-formed seeds will be found in early-cut timothy hay. The early dough stage of maturity is revealed where there is an appreciable number of half-formed green seeds. Full maturity in timothy is shown by the plump brown seeds which shell out easily from the whitish dry glumes or chaff. Timothy with seeds fully ripe usually has yellowish-brown stems and heads and many brown leaves.

Clover - The maturity of clover at time of cutting is rather difficult to determine under certain conditions after the hay has been cured. Sometimes it can be determined after cutting by observing the color and condition of bloom and the maturity of the seeds, if any are present. Clover that was cut not later than full bloom will have numerous clover heads that show the red or purplish red blossoms of the red clover, or the pink or pinkish white blossoms of alsike, provided the hay was not weathered during curing. Clover cut at this stage will have no seeds, or at most only a few shrunken seeds. A stage between full bloom and full maturity is indicated by the brown color of all the clover heads and the presence of yellowish brown seeds. Full maturity is indicated by the dark brown color of the clover heads and the presence of plump, mature seeds. Often the first crop of clover does not produce seed, however, which will account for the absence of seed in hay that has other appearance of being late cut.

Alfalfa - The stage of maturity at which alfalfa was cut is determined by observing the condition of the bloom and the texture and woodiness of the stems. Alfalfa that was cut in the bud stage can be told by the buds at the tips of the stems and by the complete absence of the purple flower petals. Bud-stage alfalfa also is usually very leafy and the stems are relatively fine and pliable. Alfalfa cut in the early-bloom stages is evidenced by some purple flower petals and some buds; the stems are harder than in bud-stage alfalfa but not so distinctly woody and hard as with alfalfa cut after it has blossomed; alfalfa so cut also is evidenced by a degree of leafiness which is distinctly apparent compared with the stemmy character of late-cut alfalfa. Alfalfa that was cut after the full-bloom stage usually is indicated by the hard stems, by the presence of seed pods, and by deficiency of leaves.

Soybean hay - The stage of maturity at which soybean hay was cut is determined by observing the development of the soybeans and of the seed pods. Early-cut soybean hay is indicated by the presence of small pods in which little or no seed has been formed. Soybean hay cut when the seed are half developed will be indicated by well-developed pods which contain small, shriveled seed. Fully-matured soybean hay will be known by its large pods, in which the seeds are plump and well developed.

There is a distinct correlation between the development of the seeds in soybean hay and the percentage of leaves. The leaves tend to turn yellow and fall from the plant as the seed develop, and when fully mature very few leaves are left on the soybean plants of most varieties, especially those grown primarily for seed. The hay varieties have a tendency to retain their leaves even when the seed are quite mature.

Johnson hay - The stage of maturity at which Johnson hay was cut can be determined by the development of the seed heads. The seed heads of relatively early-cut Johnson hay will have just started to emerge from the boot and not more than one-fourth of the heads will be out. The seed will be straw colored and may contain tinges of reddish or purplish brown. The seed heads of late-cut Johnson hay will all be out of the boot and the seeds will vary in color from reddish brown to amber. The stems of late-cut Johnson hay are usually coarse and woody and somewhat straw colored.

Grain hay - Maturity in grain hay can be determined by examining the heads and shelling out the kernels. The heads of early-cut oat and barley hay cut in the dough stage will contain half-formed kernels and may contain some filled grain. The grain in the heads of late-cut oat and barley hay is usually fully matured, and for this reason will usually shatter rather badly when handled. The heads of early-cut wheat and wild oat hay in the milk stage may contain small, shriveled kernels and some half-filled grain. As in the case of oat and barley hay the grain in the heads of late-cut wheat and wild oat hay would be fully matured.

Leafiness of legumes

The quantity of the leaves in the legumes is one of the best gages of the actual feed value of the hay. Alfalfa leaves contain on the average

about $2\frac{1}{2}$ times as much protein as the stems and about 4 times as much carotene. The leaves also contain more of the minerals especially calcium than the stems. The degree of leafiness of legume hays is influenced by time of cutting, size and length of stems, weather conditions during curing, and methods of curing and handling.

Green color

There is a relationship between the color of hay and its feed value. Natural green hay usually indicates good curing, aroma, palatability, freedom from damage, and relatively high carotene content. Carotene is an indicator of the vitamin A potency of hay. The vitamin A potency of milk and its products depends very directly on the amount of carotene in the feed of the cow. Green forage is the cheapest and most satisfactory source of carotene for cattle. But during the season when no pasture is available the carotene must be supplied by cured forage or silage. Although the cured hay does not contain as much carotene as the green forage good quality hay usually contains sufficient carotene to supply the needs of the animal. It has been found that continuous lack of carotene in the feed interferes also with normal reproduction and growth.

Loss of green color in hay may be caused by permitting the hay to become too mature before cutting, by sunbleach, dew or rain damage while being cured, and by fermentation while in storage.

Soundness

Condition of hay usually refers to its keeping qualities or soundness. Undercured hay or hay that is wet from heavy dews or rain when baled or stored loose will generally lose its green color and become musty or moldy. The extent of the damage and method of storage determines the loss in feed value of the hay. Unsoundness may render hay unfit for feeding purposes. One of the requirements of good hay is that it be sound and sweet.

Interpretation of Terms Used in "Hay Quality Specifications"

Early Cut

Refers to hay cut at a relatively early stage of growth. At this stage the hay usually supplies the greatest quantity of digestible nutrients per ton. (See "Proper stage for cutting.") Farmers should not be expected to cut hay crops too early because of the sacrifice in yields of digestible nutrients per acre and possible injury to stands, especially of alfalfa.

Overripe

Hay that is relatively late cut is overripe. Overripe hay will show discolorations due to maturity. For example, the leaves at the base of the plants are usually brown, pods of cowpeas will turn yellow and shatter before cutting, and pods of soybeans will be mature enough to cause considerable shattering of seed in curing and handling. Timothy seed will be plump and

brown and the seed heads and stems straw colored. Alfalfa plants will be in full bloom or contain green seed pods.

Badly overripe

Hay that is not cut until the plants are fully mature is considered badly overripe. Such hay usually contains ripe seed and all or a large portion of the green color is lost before the hay plants are cut. The seed heads may also be shattered. For example, the plants of badly overripe alfalfa hay will contain brown or black seed pods. Plants of badly overripe timothy will have no green color, the seed will be plump and brown, and the seed heads partly shattered. The pods of badly overripe soybean plants will be mature and most of the seed and leaves will have been lost in handling. The seed of badly overripe lespedeza plants will be mature, many of the leaves will be gone, and the stems will be harsh and woody. The heads of red clover may also be somewhat shattered and no leaves will be clinging to the stems.

Musty

Hay is musty when it has a sour, fetid odor. The odor of must in hay is a result of partial decomposition of the hay caused by excess fermentation.

Moldy

Hay is moldy when the mold may be seen on the stems and leaves of the hay with the naked eye.

Leafy

Legume hays are considered leafy when the hay contains 40 percent or more of leaves by weight. That is, the leaves will make up from slightly less than one-half to more than one-half of the total hay and the majority of the leaves will be clinging to the stems. In extra leafy hay the leaves always predominate. Because of shattering of leaves after baling, certain types of baled hay may appear stemmy when the outside of the bales are examined. No attempt should be made to determine the leaf content of baled hay of this character until one or more bales have been opened.

Moderately leafy

Legume hay containing from 25 to 40 percent of leaves by weight is moderately leafy. Hay may lose from 15 to 20 percent of its leaves during curing and handling and still be moderately leafy. This type of hay if it is not baled will have leaves only on the upper half of the stems. When such hay is baled the outside of the bales will usually have a rather stemmy appearance.

Low percentage of leaves

Legume hay with less than 25 percent of leaves by weight has a low percentage of leaves. Hay of this character will have a very stemmy appearance. A low degree of leafiness in hay is associated with coarse and woody stems, overcuring, late cutting, etc.

Natural green color

Refers to the mass green color that is natural for the kind of hay under examination. When hay is cured in the field without appreciable damage it is natural green in color. Natural green does not refer to the color of hay plants before they are cut. Practically all hay becomes slightly discolored from one cause or another during curing or while in storage. Hay may show slight discolorations from sunbleach, dew, sweating, or even a light shower and still be considered natural green. The same color standard cannot be used for all kinds of hay. For example, the natural green color of good quality timothy and Johnson hay, which is pale green, differs from that of good quality alfalfa which is strong, dark green.

Medium green to greenish brown

Hay that has lost some of its green color because of one or more heavy dews, a light shower, sunbleach, sweating, etc., is usually medium green to greenish brown in color. Hay must, however, show distinct tinges of green throughout before it can be classed as medium green to greenish brown. The mass color of medium green to greenish brown hay should be at least 25 percent green. Hay that is discolored often contains a combination of colors such as green, greenish yellow, yellowish brown, reddish brown, brown, etc.

Brown

Hay, the mass color of which is brown is called brown hay. Brown hay, however, may contain tinges of green. If the mass color of the hay is less than 25 to 30 percent green, hay is usually considered brown.

Fine-stemmed

Fine-stemmed hay is hay with relatively small stems, Lespedeza, timothy, redtop, etc., are always fine-stemmed. From three-fourths to four-fifths of the alfalfa hay crop, about four-fifths of the red clover crop, and a portion of such hay crops as soybean and cowpea would be classed as fine-stemmed. Fine-stemmed hays are usually softer and more pliable than medium or coarse stemmed hay.

Coarse and woody

Coarse and woody refers to such hays as alfalfa, cowpeas, Johnson grass, and soybean when the majority of the stalks are relatively large, hard, and brittle. When fed the butt ends of the stems of coarse and woody hay are often left in the manger.

Foreign material

Foreign material refers to weeds and certain mature grasses such as cheat, pigeon grass, broomsedge; such sedges and rushes and other plants as are coarse and woody or otherwise not suitable for feeding purposes; corn stalks, grain straw, stubble, and other objectionable matter which naturally is to be found in hay.

It is difficult for the average person to see less than 5 percent of foreign material in hay. If, however, hay contains more than 10 percent of foreign material it may be readily detected in the hay. If foreign material cannot be detected in appreciable amounts upon casual examination, the hay may be considered "good quality" from the standpoint of foreign material content. Such foreign material as dead rakings and matured cheat is relatively light in weight and the color may differ from that of the hay. The quantity of this kind of material in hay is sometimes overestimated. Certain weeds are relatively heavy when compared with the hay and are often the same color as the hay. The quantity of this kind of foreign material in hay is frequently underestimated.

Appreciable quantity of weeds or other foreign material

Hay with from 10 to 15 percent of weeds or other waste matter is said to contain an appreciable quantity of foreign matter by weight. This is about the quantity of weeds or other foreign material that is found in the average lot of hay. When hay contains this quantity of weeds the weeds show up distinctly.

Excess of weeds or other foreign material

When about one-fifth or more of the hay by weight is weeds, dead rakings, stubble, or other matter that does not have recognized feed value it contains an excess of foreign material. Early-cut grass with recognized feed value is not considered foreign material.

More than a trace of injurious foreign material

When hay has sufficient injurious foreign material to be harmful to livestock, it is said to contain more than a trace of injurious foreign material. For example, hay should be called "poor quality" when it contains enough sand burs or wild barley to injure the mucous membrane of an animal's mouth and reduce consumption of feed. What constitutes a sufficient quantity of injurious foreign material to be injurious to livestock must be left to the judgment of the feeder. Reasonable care should be used against being too technical in determining what constitutes more than a trace of injurious foreign material in hay.

Sound and sweet

Refers to hay that is not moldy, musty, or stained. Mold can be seen on the stems and leaves of the hay. The mold spores are usually white but may be brown, grey, green, or even black in color. When farmers remark that their hay is dusty they usually mean that it is covered with mold spores which will rise as dust when the hay is handled. Dust from other causes may be confused with the dust caused by mold spores. Hay that is moldy, however, is usually dull in color. This discoloration may not be evident in hay that contains small quantities of ordinary dust. The odor of dusty hay will also help one to decide whether the dust is dirt or mold spores. When the dust is caused by mold spores the hay usually contains the odor of must, which is a sour, fetid odor. Hay may be musty, however, without mold being visible to the naked eye. Moldy hay may also be musty. Care should be exercised not to confuse so-called ground odor and other odors with that of must.

Badly weathered

Hay which has been exposed to weather after cutting until all the green color is lost is badly weathered. It will have a dull, leached appearance. If it is legume hay the leaves will have been lost. It is necessary to guard against confusing badly weathered hay with hay that is badly overripe. An examination of the seed heads is helpful in this connection. Both early-cut and badly overripe hay are often badly weathered.

